IN THE DRAWINGS

The attached sheets of drawings include a replacement to Fig. 2. This drawing sheet, which includes Figs. 1 and 2, replaces the original sheet including Figs. 1 and 2.

The attached new drawing sheet includes new Fig. 3.

Attachments: Replacement Drawing Sheet and New Drawing Sheet

REMARKS/ARGUMENTS

Favorable consideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 7-14 are pending in the application, with Claim 14 added by the present amendment.

In the Advisory Action of June 20, 2005, the amendment of May 4, 2005 was not entered under an assertion that the amendment improperly adds new matter to the application. Applicants traverse the finding that the amendment of May 4, 2005 improperly added new matter to the application. However, to expedite progress toward allowance, the present amendment removes the passages identified in the Advisory Action as being objectionable.

In the Office Action of November 4, 2004, the drawings are objected to under 37, the drawings are objected to under 37 C.F.R. § 1.83(a); the specification is objected to under 35 U.S.C. § 112, first paragraph; Claims 7-13 were rejected under 35 U.S.C. § 112, first paragraph; Claims 7 and 9-13 were rejected under U.S.C. § 103(a) as being unpatentable over Street et al. (U.S. Patent No. 5,117,114); Claim 8 was rejected under U.S.C. § 103(a) as being unpatentable over Street et al. as applied to Claim 7, and further in view of Morton (U.S. Patent No. 5,693,947); Claims 7 and 9-13 were rejected under U.S.C. § 103(a) as being unpatentable over Takahashi et al. (U.S. Patent No. 5,164,973); Claim 8 was rejected under U.S.C. § 103(a) as being unpatentable over Takahashi et al. as applied to Claim 7, and further in view of Morton; Claims 7 and 9-13 were rejected under U.S.C. § 103(a) as being unpatentable over Shaw et al. (U.S. Patent No. 4,338,521); Claim 8 was rejected under U.S.C. § 103(a) as being unpatentable over Shaw et al. as applied to Claim 7, and further in view of Morton; Claims 7 and 9-13 were rejected under U.S.C. § 103(a) as being unpatentable over Franke (U.S. Patent No. 4,384,359) in view of Street et al.; and Claim 8

was rejected under U.S.C. § 103(a) as being unpatentable over Franke and Street et al. and in view of Morton.

Applicants submit that new Figure 2 and the corresponding modification to the specification overcome the objection to the drawings under 37 C.F.R. § 1.83(a), the objection to the specification under 35 U.S.C. § 112, first paragraph, and the rejection of Claims 1-7 under 35 U.S.C. § 112, first paragraph, without the introduction of new matter. New Claim 14 is directed to a method essentially corresponding to the apparatus recited in Claim 7. No new matter is added. New Figure 3 is also supported by the originally filed specification.[1] No new matter is added.

Briefly recapitulating, Claim 7 is directed to a semiconductor detector for use in a high-speed X-ray CT. The detector includes a plurality of detector modules each comprising a plurality of X-ray detection pixels arranged unidirectionally on a single planar semiconductor substrate. The plurality of detector modules are arranged polygonally around a circumference of a measuring area and placed opposite a plurality of emitters. The emitters are located outside said circumference.

As shown in Figure 2, instead of having a movable portion, the electrically controlled X-ray sources (12 and 12a) are fixed. These emitters sequentially emit pulses, which makes scanning in a few milliseconds possible. The above angular range in which the detector modules and X-ray sources may be arranged for image reconstructing called short scanning, and achieves further reduction of scanning time. Other embodiments with a different number of detector modules and X-ray sources are possible. For example, in a test performed by the inventors, eight detector modules were arranged in angular range of 240 degrees, and sixteen X-ray sources are arranged in angular range of 204 degrees. The arrangement of Figure 2, which is suitable for image reconstruction algorithms called short scanning. Such an

[1] Specification at page 8, lines 7-15

arrangement, as shown in the above-mentioned test, obtains data indispensable to image reconstructing, and shortens the scanning time to a few milliseconds. Also, the emitter plane is located slightly below the detector pixel plane, allowing the X-ray radiation to penetrate the measuring object without suffering from interference by the front edge of the detector modules.

As noted in Applicants' previous correspondence, the fast scanning X-ray CT system described in the present invention realizes drastic reduction of scanning time, as compared to Takahashi and similar devices. Applicants first note that the detector modules of the present invention are fixed along an arc whose center matches the center of the circular measuring area, unlike those of Takahashi, Street, and Shaw, all of which are examples of conventional "3rd generation CT" scanners. A key benefit of Applicants' invention is that the radius of the detector arc of the present invention may be much smaller than possible with the devices of Takahashi, Street, and Shaw. Also, the claimed arrangement of detector modules is unique to Applicants' "fast scanning X-ray CT" and is inapposite to conventional "3rd generation CT" devices such as Takahashi, Street, and Shaw, each of which include a combination of a single X-ray emitter and detectors that rotate around the measuring area. Also, Applicants' "fast scanning X-ray CT" is characterized by an X-ray emission angle that is changed as rapidly as possible by switching the ignition of each emitter electrically.

In summary, the differences of the detector modules between the 3rd generation CT systems and the fast scanning CT systems are as follows:

1) Conventional "3rd generation CT" systems do not match the center location of the arc along which each detector module is tangential with the focal point of the single X-ray emitter, whereas Applicants' "fast scanning X-ray CT" does match the center of the measuring area.

2) Conventional "3rd generation CT" systems are characterized by a large angle between the adjacent detector modules, whereas Applicants' "fast scanning X-ray CT" system has a small angle between the adjacent detector modules, which makes the curvature of the Applicants' arc different from the arc of conventional "3rd generation CT" systems.

3) Conventional "3rd generation CT" systems are characterized by a radius of the arc along which each detector module is tangential equal to the distance between the detector pixel and the single X-ray emitter, whereas in Applicants' "fast scanning X-ray CT" system, the radius is the distance between the detector pixel and the center of the measuring area, which is more appropriate for short scans in computer tomography to reduce scanning time.

With this background, it is now possible to distinguish the claimed inventions from the cited references.

Street discloses a radiation detector including an X-ray tube 211 that emits a radially directed beam 212 to a target.[2] Street does not disclose or suggest a plurality of detector modules arranged around a circumference of a measuring area and a plurality of X-ray emitters are located *outside* the circumference, as recited in Claims 7 and 12. Instead, by inspection of the Figures, the X-ray tube of Street is located at the center of the arc along which each detector module is tangential.

In addition, in Street the emitter *rotates* around the target.[3] Therefore, the device of Street suffers the same limitations as Applicants Admitted Prior Art relative to mechanically rotating emitters/detectors.[4] That is, Figure 11 of Street is an example of the previously discussed "3rd generation CT" systems, and therefore cannot complete a single scan in a few

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[2] Street, Figure 11.
[3] Street, column 9, lines 35-44.
[4] Specification, page 2, lines 8-11.

milliseconds as is possible with Applicants' invention. Applicants' claimed emitters and detectors are fixed (e.g., non-rotatable). Also, Street does not disclose or suggest an angle between the adjacent detector modules for completing fast scanning as required for fast scanning X-ray CT corresponding to Applicants' invention.

Takahashi discloses a projection detecting apparatus for computer tomography.[5] However, like Street, Takahashi does not disclose or suggest a plurality of detector modules arranged around a circumference of a measuring area and a plurality of emitters are located *outside* the circumference, as recited in Claims 7 and 12. Also like Street, the device of Takahashi includes a detector and an emitter that are jointly *rotated* around the object to be inspected.[6] Applicants' claimed emitters and detectors are fixed (e.g., non-rotatable).

Shaw discloses a tomographic apparatus including a modular detection array.[7] However, like Street and Takahashi, Shaw does not disclose or suggest a plurality of detector modules arranged around a circumference of a measuring area and a plurality of emitters are located *outside* the circumference, as recited in Claims 7 and 12. Also, detector module 46 in Figure 3 of Shaw is another example of conventional "3rd generation CT" systems. In 3rd generation systems, the X-ray direction relative to the detector modules is always the same, while in Applicants' "fast scanning CT" system, the X-ray emission direction relative to the detector modules changes as each X-ray emitter is activated. Finally, the tomographic apparatus of Shaw is rotatable. Applicants' claimed emitters and detectors are fixed (e.g., non-rotatable).

Regarding Claim 8, Applicants note that Street discloses a photolithography technique for silicon.[8] Morton discloses that pixel fabrication of Fig.5 and Fig.7 is possible using

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[5] Takahashi, column 2, lines 28-34.
[6] Takahashi, Figure 2.
[7] Shaw, column 2, lines 44-56 and Figure 1.
[8] Street, column 4, lines 35-42.

normal silicon processing techniques.[9] Morton also discloses that "Fig.6 *could* [emphasis added] be replaced by a single layer of a radiation conversion material...." However, Morton does not disclose or suggest a process taking into account of physical and mechanical properties of CdTe substrate, which is different from those of silicon. Applicants submit that CdTe detector devices cannot be made just by applying silicon process directly because of different material characteristics. Thus, Applicants' submit that applying normal silicon process to CdTe is NOT obvious to "a person having ordinary skill in the art to which said subject matter pertains." For example, it is not possible to make PN junction by injecting p-type impurity and n-type impurity, like for silicon.[10] Applicants submit it is not yet possible to form an FET on CdTe which is indispensable for switching. In addition, since CdTe is more fragile than silicon, wire bonding technique commonly used in silicon process cannot be applied. Thus, contrary to the disclosure Morton,[11] it is impossible to apply the normal silicon process to CdTe which has different properties. Furthermore, in Morton, the time constant shown in equation (4) in lines 19-24 of column 4 is preferred to be large for the constitution of the detector for 3rd generation CT systems. However, the above requirement contradicts that of the fast scanning CT of the present invention. Use of CdTe device is accordingly required as we pursue highly sensitive detector material to compensate short irradiation period of X-ray.

With regard to Shaw, as noted in the Official Action, the integrated circuit 96 of the straight modules 46 is made via photolithography. However, Applicants submit this disclosure is not pertinent to Applicants' claimed inventions since photolithography techniques used for the integrated circuit and print circuit board are totally different from that used for detector pixels. As shown in Fig. 8 in Shaw, module 46 is made of semi-conductor

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[9] Morton, column 8, lines 24-26.
[10] Morton, column 7, lines 15-23.
[11] Morton, column 10, lines 43-46.

chip 96 consisting of individual scintillator crystal and photo diode, in which a small gap exists between individual crystals. In Applicants' invention, however, pixels formed on a single substrate of CdTe have no gap between them, resulting in higher spatial resolution. Although the photo diodes can be integrated into semi-conductor chip 96, the CdTe crystal cannot be a part of the chip. CdTe substrates always reside outside the chip and are wired to a signal processing unit in a chip by a special bonding technique which is not an extrapolation from normal silicon bonding/process.

Franke is another example of the conventional "3rd generation CT" system, where the source and detector are arranged in three pairs. As shown in the reference drawing, the detector module of Franke is different from the present invention in that the center of the arc formed by the detector pixel is located at a focus of the X-ray source, whereas in Applicants' invention, the detector modules are fixed along an arc whose center matches the center of the circular measuring area. Also, the "3rd generation CT" system of Franke mechanically *rotates* around the measuring area in order to obtain data. Also, Franke does not achieve electrical scanning in a few milliseconds like the present invention. Thus, Applicants submit the combination of Franke and Street does not disclose all of the elements recited in Applicants' independent claims.

MPEP §706.02(j) notes that to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally avail-able to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Also, the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *In re Vaeck,* 947 F.2d 488, 20

USPQ2d 1438 (Fed. Cir. 1991). Without addressing the first two prongs of the test of obviousness, Applicants submit that the Official Action does not present a *prima facie* case of obviousness because each of the cited references fail to disclose all the features of Applicants' claimed invention.

Accordingly, in view of the present amendment and in light of the previous discussion, Applicants respectfully submit that the present application is in condition for allowance and respectfully request an early and favorable action to that effect.

Respectfully submitted,

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